**A lion with two spears and a rooster

Description automatically generated**

**REPUBLIC OF KENYA**

**COMPETENCY BASED MODULAR CURRICULUM**

**FOR**

**INDUSTRIAL AUTOMATION AND ROBOTICS TECHNOLOGY**

**KNQF LEVEL 5**

**PROGRAMME ISCED CODE: 0714 454A**

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**Council Secretary/CEO/Chief Principal**

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# FOREWORD

Provision of quality education and training is fundamental to the Government’s overall strategy for socio-economic development. Quality education and training contribute to achievement focused on Kenya’s development blueprint and sustainable development goals.

Reforms in the education and training sector are necessary for achievement of Kenya Vision 2030 and meeting the provisions the Constitution of Kenya. The education sector had to be aligned to the Constitution and this resulted in formulation of the Policy Framework for Reforming Education and Training (Sessional Paper No. 1 of 2019). A key feature of this policy is the change in the design and delivery of TVET training. This policy document requires that training in TVET be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery that allows for multiple entry and exit in TVET programs.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that this Curriculum has been developed.

It is my conviction that this curriculum will play a great role towards development of competent human resource for the Industrial Automation and Robotics sector’s growth and sustainable development.

**PRINCIPAL SECRETARY**

**STATE DEPARTMENT FOR TVET**

**MINISTRY OF EDUCATION**

**PREFACE**

Kenya Vision 2030 aims to transform the country into a newly industrializing, middle-income country providing high quality life to all its citizens by the year 2030. Kenya intends to create a globally competitive and adaptive human resource base to meet requirements of a rapidly industrializing economy through life-long education and training. TVET has a responsibility of facilitating the process of inculcating knowledge, skills and worker behaviour necessary for catapulting the nation to a globally competitive country, hence the paradigm shift to embrace Competency Based Education and Training (CBET).

The Technical and Vocational Education and Training Act No. 29 of 2013 and the Sessional Paper No. 1 of 2019 on Reforming Education and Training in Kenya, emphasized the need toreform curriculum development, assessment and certification. This called for a shift to CBET to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labour force.

This curriculum has been developed in adherence to the Kenya National Qualification Framework and CBETA standards and guidelines. The curriculum is designed and organized into Units of Learning with Learning Outcomes; suggested delivery methods, training/learning resources and methods of assessing the trainee’s achievement. The curriculum is competency-based and allows multiple entry and exit to the course.

I am grateful to the Council Members, Council Secretariat, …….. NSSC, expert workers and all those who participated in the development of this curriculum.

**Council Secretary/CEO/Chief Principal**

# ACKNOWLEDGEMENT

This curriculum has been designed for competency-based training and has independent units of learning that allow the trainee flexibility in entry and exit. In developing the curriculum, significant involvement and support was received from industry and various organizations.

I appreciate National Industrial Automation and Robotics Sector Skills Committee who enabled the development of this curriculum. I recognize with appreciation the role of the SSC in ensuring that competencies required by the industry are addressed in this curriculum.

I also thank all stakeholders in the industrial automation and robotics sector for their valuable input and all those who participated in the process of developing this curriculum.

I am convinced that this curriculum will go a long way in ensuring that workers in industrial automation and robotics sector will acquire competencies that will enable them perform their work more efficiently.

**Council Secretary/CEO/Chief Principal**

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# TABLE OF CONTENTS

[FOREWORD 3](#_Toc197017751)

[ACKNOWLEDGEMENT 5](#_Toc197017752)

[TABLE OF CONTENTS 6](#_Toc197017753)

[ABBREVIATIONS AND ACRONYMS 7](#_Toc197017754)

[KEY TO ISCED UNIT CODE 8](#_Toc197017755)

[COURSE OVERVIEW 9](#_Toc197017756)

[MODULE ONE 13](#_Toc197017757)

[MODULE TWO 31](#_Toc197017758)

[MODULE THREE 49](#_Toc197017759)

[MODULE FOUR 84](#_Toc197017760)

[MODULE FIVE 110](#_Toc197017761)

# ABBREVIATIONS AND ACRONYMS

CAD Computer Aided Design

CCTV Closed Circuit Tele Vision

EHS Environment Health and Safety

HVAC Heating Ventilation and Air Conditioning

IBMS Integrated Building Management System

IEE Institute of Electrical Engineers

K.C.S. E Kenya Certificate of Secondary Education

KEBS Kenya Bureau of Standards

KNQA Kenya National Qualification Authority

KNQF Kenya National Qualification Framework

KPLC Kenya Power and Lighting Company

NCA National Construction Authority

NEMA National Environment Management Authority

OSHA Occupational Safety and Health Act

PPE Personal Protective Equipment

PV Photo Voltaic

TVET Technical and Vocational Education and Training

WIBA Work Injury Benefits Act

# KEY TO ISCED UNIT CODE



# COURSE OVERVIEW

This Industrial Automation and Robotics Level 5 curriculum is designed to equip an industrial automation and robotics operator with the competencies required to: operate industrial automation and robotic systems, maintain industrial automation and robotic systems and maintain product quality

**SUMMARY OF UNITS OF COMPENTENCY**

**INDUSTRIAL AUTOMATION AND ROBOTICS LEVEL 5**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **MODULE** | **UNITS** | | | |
| **UNIT**  **CATEGORY** | **UNIT CODE** | **UNIT NAME** | **DURATION(Hours)** |
| **ONE (I)** | CORE | 0714 351 06A | Industrial Automation and Robotic Systems Operations | 250 |
| CORE | 0714 351 08A | Product Quality Maintenance | 140 |
| **SUB TOTAL** | | | **390** |
| **TWO (II)** | **CORE** | 0714 351 07A | Industrial Automation and Robotic Systems Maintenance | 220 |
| **SUB TOTAL** | | | **220** |
| **THREE(III)** | **BASIC** | 0611 441 01A | Digital Literacy | 40 |
| **COMMON** | 0541 441 05A | Engineering mathematics | 150 |
| **CORE** | 0714 451 09A | Industrial automation electrical systems installation and maintenance | 170 |
| **SUB TOTAL** | | | **360** |
| **FOUR(IV)** | **CORE** | 0714 451 10A | Stand-alone controlled systems installation and maintenance. | 200 |
| **CORE** | 0714 451 11A | Pneumatic System Installation and Maintenance | 220 |
| **SUB TOTAL** | | | **420** |
| **FIVE(V)** | **BASIC** | 0031 441 02A | Communication Skills | 40 |
| **BASIC** | 0413 441 04A | Entrepreneurial Skills | 40 |
| **BASIC** | 0417 441 03A | Work Ethics and Practices | 40 |
| **CORE** | 0714 451 12A | Hydraulic systems installation and maintenance. | 220 |
|  | **SUB TOTAL** | | | **340** |
|  |  |  | **INDUSTRIAL ATTACHEMENT** | 480 |
|  |  |  |  | **Grand Total:**  **2210HRS** |

The total duration for this course is 2210 hours.

**Entry Requirements**

An individual entering this course should have any of the following minimum requirements:

1. Kenya certificate of secondary education (K.C.S.E.) with a minimum mean grade of D (Plain) or KCE division IV or its equivalent as determined by the regulator

**Or**

1. Industrial automation and robotics KNQF level 4 certificate or its equivalent as determined by TVETA.

**Trainer Qualification**

Qualifications of a trainer for this course include:

1. Have a minimum of KNQF Level 6 qualification or its equivalent in a related trade area.
2. Be licensed by TVETA.

**Industry Training**

An individual enrolled in this course will be required to undergo Industry training for a minimum period of ……480… hours in … industrial automation and robotics …… sector. The industrial training may be taken after completion of all units for those pursuing the full qualification or be distributed equally in each unit for those pursuing part qualification. In the case of dual training model, industrial training shall be as guided by the dual training policy.

**Assessment**

The course shall be assessed formatively and summatively:

1. During formative assessment all performance criteria shall be assessed based on performance criteria weighting.
2. Number of formative assessments shall minimally be equal to the number of elements in a unit of competency.
3. For qualification packs that commence at levels 3 or 4, assessments of modules 1 and 2 shall be in accordance with assessment guidelines for levels 3 and 4.
4. During summative assessment basic and common units may be integrated in the core units or assessed as discrete units.
5. Theoretical and practical weighting for each unit of learning shall be as follows:
6. 10:90 units in module 1 and module 2
7. 30:70 for units in module 3 to module 5
8. Formative and summative assessments shall be weighted at 60% and 40% respectively in the overall unit of learning score
9. For a candidate to be declared competent in a unit of competency, the candidate must meet the following conditions:
10. Obtained at least 40% in theory assessment in formative and summative assessments.
11. Obtained at least 60% in practical assessment in formative and summative assessment where applicable.
12. Obtained at least 50% in the weighted results between formative assessment and summative assessment where the former constitutes 60% and the latter 40% of the overall score.
13. Assessment performance rating for each unit of competency shall be as follows:

|  |  |
| --- | --- |
| **MARKS** | **COMPETENCE RATING** |
| 80 -100 | Attained Mastery |
| 65 – 79 | Proficient |
| 50 – 64 | Competent |
| 49 and below | Not Yet Competent |
| Y | Assessment Malpractice/irregularities |

1. Assessment for Recognition of Prior Learning (RPL) may lead to award of part and/or full qualification.

**Certification**

A candidate will be issued with a Certificate of Competency upon demonstration of competence in a unit of competency. To attain Kenya National TVET Certificate in industrial automation and robotics Level 5, the candidate must demonstrate competence in all the units of competency as given in qualification pack. Statement of Attainment certificate may be awarded upon demonstration of competence in certifiable element within a unit

These certificates will be issued by ……… (QAI)

MODULE ONE

## INDUSTRIAL AUTOMATION AND ROBOTIC SYSTEMS OPERATION

**UNIT CODE:** 0714 351 06A

**UNIT DURATION: 250 HOURS**

**Relationship to Occupational Standards**

**This unit addresses the unit of competency**: Operate industrial automation and robotic systems

**Unit Description**

UNIT DESCRIPTION

This unit covers the competencies required in operation of an industrial automation and robotics systems. The competencies include; operating computer devices, applying digital electronic principles, controlling industrial automation and robotic systems, monitoring industrial automation and robotic systems and setting industrial automation and robotic system parameters.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| S/No | Learning Outcomes | **Duration (Hrs.)** |
| 1 | Operate computer devices | **30** |
| 2 | Apply digital electronic principles | **30** |
| 3 | Control industrial automation and robotic system | **80** |
| 4 | Monitor industrial automation and robotic system robotic system parameters | **50** |
| 5 | Set industrial automation and robotic system parameters | **60** |
|  | **TOTAL** | **250 HRS** |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Operate computer devices | * 1. Meaning and importance of digital literacy      1. Procedure for turning/off a computer      2. Types of computer devices (tablets, desktop, and laptop computers).   2. Components of a computer system   3. Computer Hardware      1. The System Unit E.g. motherboard, CPU, casing,      2. Input devices e.g. pointing, keying, scanning, voice/speech recognition, direct data capture devices.      3. Output devices e.g. hardcopy output and softcopy output      4. Storage devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, hard drives, CDs & DVDs, memory cards, flash drives      5. Computer ports e.g. HDMI, DVI, VGA, USB type C, etc.   4. Start menu commands and desktop manipulation   5. Mouse use techniques   6. Keyboard parts and use techniques   7. File and files management using an operating system   8. Computer internet connection options      1. Mobile networks/data plans      2. Wireless hotspots      3. Cabled (Ethernet)   9. Mechanisms for storing files (flash drives, hard drives).   10. Computer external devices management       1. Device connections       2. Device controls (volume controls and display properties) | * Observation * Oral assessment * Portfolio of evidence * Third party report * Written assessment * Practical |
| 1. Apply digital electronic principles | * 1. Number system concepts      1. Introduction to number systems: binary, decimal, hexadecimal      2. Conversion between number systems      3. Applications in digital electronics   2. Digital logic gate concepts      1. Introduction to logic gates: AND, OR, NOT, NAND, NOR, XOR      2. Truth tables and Boolean algebra | * Observation * Oral assessment * Portfolio of evidence * Third party report * Written assessment * Practical |
| 1. Control industrial automation and robotic system | * 1. Applications of industrial automation and robotics control systems:      1. Programmable logic controllers      2. Human machine interface      3. Sensors      4. Actuators      5. Robotic arms      6. Robotic manipulators      7. Robotic end effectors      8. Motion control systems   2. PPEs      1. Apron      2. Safety boots      3. Goggles      4. Hand gloves      5. Helmet         1. Industrial automation and robotic system operational manual interpretation         2. Start up and shut down of industrial automation and robotic systems         3. Material flow control         4. Uses of industrial automation and robotic system safety devices      6. Guards      7. Interlocks      8. Emergency push buttons   3. Practice: control industrial automation and robotics system | * Observation * Oral assessment * Portfolio of evidence * Third party report * Written assessment * Practical |
| 1. Monitor industrial automation and robotic system robotic system parameters | * 1. Uses of industrial automation and robotic monitoring systems.      1. Functions of industrial monitoring sensors         1. Pressure sensors         2. Position sensors         3. Infra-red sensors         4. Proximity sensors         5. Level sensors         6. Speed sensors         7. 2.1.2 Dashboards         8. Dash board types      2. Human machine interfaces      3. Display monitors         + 1. Utilisation of industrial automation and robotic system visualisation tools   2. Robotic system monitoring and control software      1. Industrial automation and robotic system technical parameters         1. Temperature         2. Pressure         3. Flow rate         4. Displacement         5. Speed         6. Vibration         7. Load and force         8. Power consumption         9. Environmental conditions   3. Practice: Monitor industrial automation and robotic system parameters | * Observation * Oral assessment * Portfolio of evidence * Third party report * Written assessment * Practical |

|  |  |  |
| --- | --- | --- |
| 1. Set industrial automation and robotic system parameters | * 1. Industrial automation and robotics      1. System process recipe      2. Selecting recipe from the database      3. Reviewing the recipe settings      4. Applying the recipe to the system   2. Industrial automation and robotic system process parameters identification      1. Temperature      2. Pressure      3. Level      4. Material amount   3. Process parameters configuration:      1. Preparations for configuration      2. Process parameters Identification      3. Setting up parameters on the control interface      4. Calibration and tuning of the system      5. Performing safety checks      6. Monitoring and fine-tuning during operation      7. Documenting the configuration   4. Practice: Set industrial automation and robotic system parameters | * Project * Practical * Oral questioning * Third party report * Portfolio of evidence * Written tests |

**Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Tools** | | | |
|  | Screwdriver Sets | Assorted screwdrivers for various applications | 2 sets | 2:25 |
|  | Wrench Sets | Assorted wrenches for mechanical work | 2 sets | 2:25 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Spacious, equipped with projectors and seating for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Hands-on training area with workbenches, tools, and safety equipment, approximately 80 sqm | 1 | 1:25 |
|  | Laboratory | Equipped with robotics training kits for experiments, approximately 50 sqm | 1 | 1:25 |
| **C** | **Materials and Supplies** | | | |
|  | Guards | Safety guards for equipment operation | 1 | 1:25 |
|  | Interlocks | Safety interlocks for machinery | 1 | 1:25 |
|  | Emergency Push Buttons | Emergency stop buttons for training setups | 1 | 1:25 |
| **D** | **Equipment** | | | |
|  | Industrial Automation Kits | Complete training kits for automation and robotics | 2 | 2:25 |
|  | User Manuals | Manuals for industrial automation training | 2 | 2:25 |
|  | Hydraulic Training Kits | Kits for hydraulic systems training | 2 | 2:25 |
|  | Pneumatics Training Kits | Kits for pneumatic systems training | 2 | 2:25 |
|  | PPE Sets | Personal protective equipment for all trainees | 25 sets | 1:1 |
|  | PLC Panels | Programmable logic controller panels for training | 2 | 2:25 |
|  | HMI Panels | Human-machine interface panels for training | 2 | 2:25 |
| **E** | **Reference Materials** | | | |
|  | OSHA Documentation | Occupational Safety and Health Act resources | 1 | 1:25 |
|  | Automation Books | Books on industrial automation and robotics systems operation | 1 | 1:25 |

## PRODUCT QUALITY MAINTANANCE

**ISCED UNIT CODE:** 0714 351 08A

**UNIT DURATION: 140 HOURS**

**Relationship to Occupational Standards**

**This unit addresses the unit of competency:** Maintain product quality

**Unit Description**

This unit covers the competencies required by an industrial automation and robotics system operator to maintain quality of products produced through an industrial automated system. These competencies include; conducting product quality checks, adjusting industrial automation and robotics machinery stetting and documenting production quality activities.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| S/No | Learning Outcome | **Duration (Hrs.)** |
| 1 | Conduct product quality checks | **40** |
| 2 | Document production quality activities | **40** |
| 3 | Adjust industrial automation and robotics machinery settings | **60** |
|  | **TOTAL** | **140 HRS** |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Conduct product quality checks | * 1. Workplace procedures and inspection.   2. Preparation of the inspection area and equipment   3. Inspection of product according to procedures   4. Uses of product quality monitoring equipment      1. Dimensional measurement systems      2. Automated cameras      3. Vision sensors      4. Surface profilometers      5. Ultrasonic testing equipment   5. Handling defective products   6. Practice: conducting quality checks on by products | * Project * Practical * Oral questioning * Third party report * Portfolio of evidence * Written tests |
| 1. Document production quality activities | * 1. Recording of industrial automation and robotics conforming products      1. Criteria for conformance definition      2. Utilization of automation systems to capture conformance data      3. Setting up data logging for conforming products      4. Verification and validation of product conformance      5. Generation of reports for conforming product   2. Recording of industrial automation and robotics non-conforming products      1. Criteria for non-conformance definition      2. Utilization of automation systems to capture non-conformance products      3. Setting up data logging for non-conforming products      4. Non-conforming products separation and labelling      5. Documentation of non-conformance details      6. Analyzing and classifying non-conformance records      7. Generating non-conformance Reports   3. Recording of industrial automation and robotics machine setting deviations.      1. Reporting and documentation of settings deviations.      2. Preventive measures implementation   4. Practice: Product quality documentation   5. Excursion on product quality maintenance | * Project * Practical * Third party report * Portfolio of evidence * Oral questioning * Written tests |
| 1. Adjust industrial automation and robotics machinery settings | * 1. Uses of PPE      + 1. Apron        2. Safety boots        3. Goggles        4. Hand gloves        5. Helmet   2. Industrial automation and robotics machine setting deviations      + 1. Identification of the source of the deviation        2. Assessment of the impact of the deviation        3. Investigation of potential causes of the deviation   3. Uses of industrial automation and robotics machinery setting adjustment tools and equipment      1. Tools         1. Hand tools            1. Calibrators            2. Thermometers            3. Pressure gauges            4. Micrometres            5. Vernier callipers            6. Tachometers            7. Accelerometers      2. Equipment         1. Lifting gear         2. Change parts         3. Personal computers         4. PPE         5. Product quality monitoring equipment         6. Human machine interfaces Practical assessment   4. Elimination of industrial automation and robotics machine setting deviations      + 1. Cleaning and maintenance of inspection equipment        2. Deviation correction and Settings reconfiguration        3. System monitoring after correction   5. Practice: setting and adjust industrial automation and robotics machinery settings | * Project * Practical * Third party report * Portfolio of evidence * Oral questioning * Written tests |

**Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Tools** | | | |
|  | Assorted Tools | General tools for various applications | Adequate |  |
|  | Calibrators | For ensuring accuracy of measurement instruments | 2 | 2:25 |
|  | Thermometers | For measuring temperature | 2 | 2:25 |
|  | Pressure Gauge | For measuring pressure in systems | 1 | 1:25 |
|  | Micrometers | For precise measurement of small dimensions | 5 | 1:5 |
|  | Vernier Calipers | For measuring internal and external dimensions | 5 | 1:5 |
|  | Tachometers | For measuring rotational speed | 2 | 2:25 |
|  | Accelerometers | For measuring acceleration | 1 | 2:25 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory room | Spacious, equipped with projectors and seating for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Hands-on training area with workbenches, tools, and safety equipment, approximately 80 sqm | 1 | 1:25 |
|  | Laboratory | Equipped with robotics training kits for experiments, approximately 50 sqm | 1 | 1:25 |
| **C** | **Materials and Supplies** | | | |
|  | Dimensional measurement systems | Systems for measuring dimensions accurately | 1 | 1:25 |
|  | Automated cameras | For visual inspection and monitoring | 1 | 1:25 |
|  | Vision sensors | For detecting and measuring visual parameters | 1 | 1:25 |
| **D** | **Equipment** | | | |
|  | Industrial automation kits | Complete training kits for automation and robotics | 2 | 2:25 |
|  | User manuals | Manuals for available industrial automation training | 2 | 2:25 |
|  | Service manuals | Manuals for servicing training equipment | 1 | 1:25 |
|  | PPE sets | Personal protective equipment for all trainees | 25 sets | 1:1 |
|  | PLC panels | Programmable logic controller panels for training | 2 | 2:25 |
|  | HMI panels | Human-machine interface panels for training | 2 | 2:25 |
|  | Product quality monitoring equipment | For monitoring quality in production processes | 1 | 1:25 |
|  | Surface profilometers | For measuring surface roughness and texture | 1 | 1:25 |
|  | Ultrasonic testing equipment | For non-destructive testing of materials | 1 | 1:25 |
| **E** | **Reference Materials** | | | |
|  | OSHA documentation | Occupational Safety and Health Act resources | 1 | 1:25 |
|  | Online course materials | Access links, user guides, and handouts from platforms | 1 set | 1:25 |
|  | Printed reference booklets | Summarizing quality control and assurance essentials | 1 set | 1:25 |
|  | Workbooks | Exercises on inspection, defect analysis, and corrective actions | 1 set | 1:25 |

MODULE TWO

## INDUSTRIAL AUTOMATION AND ROBOTIC SYSTEMS MAINTENANCE

**UNIT CODE:** 0714 351 07A

**UNIT DURATION: 220 HOURS**

**Relationship to Occupational Standards**

**This unit addresses the unit of competency**: Operate industrial automation and robotic systems

**Unit Description**

This unit covers the competencies required by an operator to carry out maintenance of industrial automation and robotic systems. These competencies include; applying workshop safety, performing housekeeping, carrying out industrial automation and robotic system autonomous maintenance, carrying out industrial automation and robotic system troubleshooting and replacing industrial automation and robotic system parts

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| S/No | Learning Outcome | **Duration (Hrs.)** |
| 1 | Apply workshop safety | **40** |
| 2 | Perform housekeeping | 30 |
| 3 | Carry out industrial automation and robotic system autonomous maintenance |  |
| 4 | Carry out industrial automation and robotic system troubleshooting | 70 |
| 5 | Replace industrial automation and robotic system parts | 80 |
|  |  | **TOTAL 220HRS** |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + - 1. Apply workshop safety | * 1. Workshop safety      1. Definition      2. Types and uses of PPE’s   2. Emergence responses steps      1. Common emergencies         1. Fire         2. Chemical spills         3. Injury response   3. Fire safety      1. Fire extinguishers types and uses      2. Flammable materials identification      3. Fire prevention   4. Safe handling and disposal of chemicals and materials      1. Chemical hazard identification      2. Safe handling procedure      3. Storage and labelling of chemicals      4. Chemical disposal procedures      5. Emergency response for chemical exposure   5. Identifying and marking hazardous zones      1. Common hazardous zones         1. Flammable zones         2. High traffic zones         3. Electrical hazard zones         4. Chemical storage areas   6. Work area organization and maintenance      1. Setting up      2. Proper storage and labelling of tools and equipment   7. Workplace hazards      1. Physical hazards         1. Noises         2. Vibration         3. Heat         4. Sharp object      2. Chemical hazards         1. Fuels         2. Oils         3. Cleaning agents      3. Electric hazards         1. Live wires         2. Batteries         3. Electrical systems   8. Workshop accidents, causes and responses      1. Slip, strips and falls      2. Cuts and abrasion      3. Burns      4. Electrical shocks | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |
| * + - 1. Perform housekeeping | * 1. Housekeeping.      1. Definition      2. Importance of housekeeping   2. Housekeeping activities and their importance      1. Tool and equipment organization      2. Work area cleanliness      3. Safe handling and disposal of hazardous materials      4. Inspection and maintenance of equipment      5. Personal protective equipment management      6. Air and ventilation maintenance      7. Incident prevention and reporting   3. Housekeeping tools and equipment      1. Uses and maintenance      2. Brooms and brushes         1. Dustpans and squeegees         2. Vacuum cleaners         3. Mops and mop buckets         4. Waste bins and recycling containers   4. Housekeeping materials      1. Cleaning cloths and rags      2. Cleaning agents and solvents      3. Lubricants      4. Gloves and PPE’s      5. Disposable bags and liners   5. Workshop waste sorting and disposal      1. Types of waste         1. General waste         2. Hazardous waste         3. Recyclable waste         4. Organic waste         5. E-waste      2. Waste sorting procedure         1. Designated bins for different types of waste         2. Sorting by material         3. Pre-sorting hazardous waste      3. Hazardous waste disposal         1. Chemical waste         2. Used oil and solvents         3. Paints and finishes | * Practical * Project * Portfolio of evidence * Third party report * Written tests. |
| * + - 1. Carry out industrial automation and robotic system autonomous maintenance | * 1. Identification of industrial automation and robotic system autonomous maintenance tasks:   Routine inspection   * + 1. Cleaning     2. Degreasing     3. Lubrication     4. Tightening     5. Aligning   1. Uses of industrial automation and robotic system autonomous maintenance tools and equipment   2. Tools      1. Flashlights      2. Hand tools      3. Thermal imaging cameras      4. Grease guns      5. Oil guns      6. Oil dispensers      7. Tachometers      8. Vibration meters      9. Multimeters   3. Equipment      1. Air compressors      2. Solvent sprayers      3. Safety equipment   4. Uses of PPE      1. Apron      2. Safety boots      3. Goggles      4. Hand gloves      5. Helmet   5. Interpretation of industrial automation and robotic system service manual   6. Industrial automation and robotic system autonomous maintenance tasks:      1. Routine inspection      2. Cleaning      3. Degreasing      4. Lubrication      5. Tightening      6. Aligning   7. Industrial automation and robotic system autonomous maintenance checklists preparation   8. Industrial automation and robotic system autonomous maintenance checklists filling   9. Practice: maintain industrial automation and robotic system. | * Carry out industrial automation and robotic system autonomous maintenance |
| * + - 1. Carry out industrial automation and robotic system troubleshooting | * 1. Identification of industrial automation and robotic system alerts:      1. Warnings      2. Alarms   2. Industrial automation and robotic system alerts clearance      1. Identifying the type and source of the alert      2. Understanding the alert description and code      3. Performing initial troubleshooting      4. Clearing mechanical or electrical issues      5. Verifying software and control system configurations      6. Performing safety checks      7. Clearing the alert on the control Interface      8. Documenting the alert and corrective actions      9. Testing the system before full operation   3. Practice: troubleshoot industrial automation and robotics system | * Carry out industrial automation and robotic system troubleshooting |
| * + - 1. Replace industrial automation and robotic system parts | * 1. Consumable industrial automation and robotic system parts identification and usage      1. Bearings         1. Types of bearing         2. Causes of bearing wear         3. Symptoms of worn-out bearing      2. Seals and gaskets         1. Types of sealants and gaskets         2. Cause of worn-out seals and gaskets         3. Symptoms of worn-out seals and gaskets of      3. Filters         1. Types of filters         2. Maintenance of filters      4. Belts and chains         1. Types of belts and chains         2. Causes of worn-out belts and chains         3. Symptoms of worn-out belts and chains      5. Wear plates and liners         1. Types of plates and liners         2. Causes of worn-out plates and liners         3. Symptoms of worn-out plates and liners      6. Cutting tools         1. Types of cutting tools         2. Maintenance of cutting tools      7. Batteries and power sources         1. Types of batteries and power sources         2. Maintenance of batteries and power sources   2. Purpose of tools and equipment used in replacement of industrial automation and robotics system parts      1. Tools         1. Flashlights         2. Hand tools         3. Thermal imaging cameras         4. Grease guns         5. Oil guns         6. Oil dispensers         7. Tachometers         8. Vibration meters         9. Multimeters      2. Equipment         1. Air compressors         2. Solvent sprayers         3. Safety equipment   3. Industrial automation and robotic system consumable parts service      1. Replenish lubricants      2. Cleaning equipment      3. Replace worn out parts      4. Replenishing cooling fluids      5. Service record documentation      6. Housekeeping activities after service   4. Practice: repair and maintenance of industrial automation and robotics system. | * Replace industrial automation and robotic system parts |

**Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Tools** | | | |
|  | Screwdriver Sets | Assorted screwdrivers for various applications | 2 sets | 2:25 |
|  | Wrench Sets | Assorted wrenches for mechanical work | 2 sets | 2:25 |
|  | Digital Flashlights | Portable flashlights for visibility during hands-on work | 2 | 2:25 |
|  | Grease Guns | For applying grease to machinery | 2 | 2:23 |
|  | Digital Multimeters | For voltage, current, and resistance measurements | 2 | 2:25 |
|  | Oil Guns | For applying oil to machinery | 2 | 2:25 |
|  | Oil Dispensers | For dispensing oil accurately | 2 | 2:25 |
|  | Tachometers | For measuring rotational speed | 2 | 2:25 |
|  | Vibration Meter | For measuring vibration levels in equipment | 1 | 1:25 |
|  | Cutting Tools | For cutting materials in practical applications | 2 | 2:25 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Spacious, equipped with projectors and seating for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Hands-on training area with workbenches, tools, and safety equipment, approximately 80 sqm | 1 | 1:25 |
|  | Laboratory | Equipped with robotics training kits for experiments, approximately 50 sqm | 1 | 1:25 |
| **C** | **Materials and Supplies** | | | |
|  | Sensors | For detecting various parameters in automation systems | 5 | 1:5 |
|  | Actuators | For controlling movement in mechanical systems | 5 | 1:5 |
|  | Bearings | For reducing friction in rotating components | 5 | 1:5 |
|  | Seals and Gaskets | For preventing leaks and maintaining pressure | 5 | 1:5 |
|  | Filters | For purifying fluids in systems | 3 | 1:8.3 |
|  | Belts and Chains | For power transmission in machinery | 2 | 1:12.5 |
|  | Wear Plates and Liners | For reducing wear in machinery components | 2 | 1:12.5 |
|  | Batteries and Power Sources | For powering equipment and sensors | 2 | 1:12.5 |
| **D** | **Equipment** | | | |
|  | Industrial Automation Kits | Complete training kits for automation and robotics | 2 | 1:12.5 |
|  | Hydraulic Training Kits | Kits for hydraulic systems training | 2 | 1:12.5 |
|  | Pneumatics Training Kits | Kits for pneumatic systems training | 2 | 1:12.5 |
|  | User Manuals | Manuals for each available training kit | 1 | 1:25 |
|  | Service Manuals | Manuals for servicing training equipment | 1 | 1:25 |
|  | PPE Sets | Personal protective equipment for all trainees | 25 sets | 1:1 |
|  | PLC Panels | Programmable logic controller panels for training | 2 | 1:12.5 |
|  | HMI Panels | Human-machine interface panels for training | 2 | 1:12.5 |
| **E** | **Reference Materials** | | | |
|  | OSHA Documentation | Occupational Safety and Health Act resources | 1 | 1:25 |
|  | Maintenance Books | Books on industrial automation and robotics systems maintenance | 1 | 1:25 |

MODULE THREE

## DIGITAL LITERACY

**ISCED UNIT CODE:** 0611 441 01A

**Relationship with occupational standards**

This unit addresses the unit of competency: Apply digital literacy

**Duration of unit: 40 Hours**

**Unit description**

This unit covers the competencies required to demonstrate digital literacy. It involves operating computer devicessolving tasks using the Office suite, managing data and information, performing online communication and collaborations, applying cybersecurity skills, performing jobs online and applying job entry techniques.

**Summary of learning outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcome** | **Duration (Hrs.)** |
|  | Operate computer devices | **6** |
|  | Solve Tasks Using Office Suite | **14** |
|  | Manage Data and Information | **6** |
|  | Perform Online Communication and Collaborations | **4** |
|  | Apply Cybersecurity Skills | **4** |
|  | Perform Online Jobs | **4** |
|  | Apply job entry techniques. | **2** |
|  | **TOTAL** | **40 HRS** |

**Learning outcomes, content, and suggested assessment methods**

| **Learning outcome** | **Content** | **Suggested**  **assessment methods** |
| --- | --- | --- |
| 1. Operate computer devices | * 1. Meaning and importance of digital literacy   2. Functions and Uses of Computers   3. Classification of computers   4. Components of a computer system   5. Computer Hardware   6. The System Unit E.g. Motherboard, CPU, casing   7. Input Devices e.g. Pointing, keying, scanning, voice/speech recognition, direct data capture devices.   8. Output Devices e.g. hardcopy output and softcopy output   9. Storage Devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, Hard Drives, CDs & DVDs, Memory cards, Flash drives   10. Computer Ports e.g. HDMI, DVI, VGA, USB type C etc.   11. Classification of computer software   12. Operating system functions   13. Procedure for turning/off a computer   14. Mouse use techniques   15. Keyboard Parts and Use Techniques   16. Desktop Customization   17. File and Files Management using an operating system   18. Computer Internet Connection Options       1. Mobile Networks/Data Plans       2. Wireless Hotspots       3. Cabled (Ethernet/Fiber)       4. Dial-Up       5. Satellite       6. Computer external devices management   19. Device connections   20. Device controls (volume controls and display properties) | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| 1. Solve tasks using office suite | * 1. Meaning and importance of word processing   2. Examples of word processors   3. Working with word documents      1. Open and close word processor      2. Create a new document      3. Save a document      4. Switch between open documents   4. Enhancing productivity      1. Set basic options/preferences      2. Help resources      3. Using magnification/zoom tools      4. Display, hide built-in tool bar      5. Using navigation tools   5. Typing text   6. Document editing (copy, cut, paste commands, spelling and grammar check)   7. Document formatting      1. Formatting text      2. Formatting paragraph      3. Formatting styles      4. Alignment      5. Creating tables      6. Formatting tables   8. Graphical objects      1. Insert object (picture, drawn object)      2. Select an object      3. Edit an object      4. Format an object   9. Document print setup      1. Page layout,      2. Margins set up      3. Orientation.   10. Word document printing   11. Meaning & importance of electronic spreadsheets   12. Components of spreadsheets   13. Application areas of spreadsheets   14. Using spreadsheet application       1. Parts of excel screen: ribbon, formula bar, active cell, name box, column letter, row number, quick access toolbar.       2. Cell data types       3. Block operations       4. Arithmetic operators (formula bar (-, +, \*, /).       5. Cell referencing   15. Data manipulation       1. Using functions (Sum, average, sum if, count, max, max, if, rank, product, mode etc)       2. Using formulae       3. Sorting data       4. Filtering data       5. Visual representation using charts   16. Worksheet printing   17. Electronic presentations   18. Meaning and importance of electronic presentations   19. Examples of presentation software   20. Using the electronic presentation application       1. Parts of the PowerPoint screen (slide navigation pane, slide pane, notes, the ribbon, quick access toolbar, and scroll bars).       2. Open and close presentations       3. Creating slides (insert new slides, duplicate, or reuse slides.)       4. Text management (insert, delete, copy, cut and paste, drag and drop, format, and use spell check).       5. Using magnification/zoom tools       6. Apply or change a theme.       7. Saving a presentation       8. Switching between open presentations   21. Developing a presentation       1. Presentation views       2. Slides       3. Master slide   22. Text       1. Editing text       2. Formatting       3. Tables   23. Charts       1. Using charts       2. Organization charts   24. Graphical objects       1. Insert, manipulate       2. Drawings   25. Prepare outputs       1. Applying slide effects and transitions       2. Check and deliver          1. Spell check a presentation          2. Slide orientation          3. Slide shows, navigation   26. Print presentations (slides and handouts) | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| 1. Manage data and information | * 1. Meaning of data and information   2. Importance and uses of data and information   3. Types of internet services      1. Communication Services      2. Information retrieval services      3. File transfer      4. World wide web services      5. Web services      6. Automatic network address configuration      7. News group      8. Ecommerce   4. Types of internet access applications   5. Web browsing concepts      1. Key concepts      2. Security and safety   6. Web browsing      1. Using the web browser      2. Tools and settings      3. Clearing cache and cookies      4. URIs      5. Bookmarks      6. Web outputs   7. Web based information      1. Search      2. Critical evaluation of information      3. Copyright, data protection   8. Downloads management   9. Performing digital data backup (Online and offline)   10. Emerging issues in internet | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| 1. Perform online communication and collaboration | * 1. Netiquette principles   2. Communication concepts      1. Online communities      2. Communication tools      3. Email concepts   3. Using email      1. Sending email      2. Receiving email      3. Tools and settings      4. Organizing email   4. Digital content copyright and licenses   5. Online collaboration tools      1. Online Storage (Google Drive)      2. Online productivity applications (google docs & forms)      3. Online meetings (google meet/zoom)      4. Online learning environments      5. Online calendars (google calendars)      6. Social networks (Facebook/twitter - settings & privacy)   6. Preparation for online collaboration      1. Common setup features      2. Setup   7. Mobile collaboration      1. Key concepts      2. Using mobile devices      3. Applications      4. Synchronization | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| 1. Apply cybersecurity skills | * 1. Data protection and privacy      1. Confidentiality of data/information      2. Integrity of data/information      3. Availability of data/information   2. Internet security threats      1. Malware attacks      2. Social engineering attacks      3. Distributed denial of service (DDoS)      4. Man-in-the-middle attack (MitM)      5. Password attacks      6. IoT attacks      7. [Phishing attacks](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#phishing-attacks)      8. [Ransomware](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#ransomware)   3. Computer threats and crimes   4. Cybersecurity control measures      1. Physical controls      2. Technical/logical controls (passwords, Pins, biometrics)      3. Operational controls   5. Laws governing protection of ICT in Kenya      1. The Computer Misuse and Cybercrimes Act No. 5 of 2018      2. The data protection Act No. 24 Of 2019 | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| 1. Perform online Jobs | * 1. Introduction to online working   2. Types of online jobs   3. Online job platforms      1. Remo task      2. Data annotation tech      3. Cloud worker      4. Upwork      5. Oneforma      6. Appen   4. Online account and profile management   5. Identifying online jobs/job bidding   6. Online digital identity   7. Executing online tasks   8. Management of online payment accounts. | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| 1. Apply job entry techniques | * 1. Types of job opportunities      1. Self-employment      2. Service provision      3. product development      4. salaried employment         1. Sources of job opportunities   2. Resume/ curriculum vitae      1. What is a CV      2. How long should a CV be      3. What to include in a CV      4. Format of CV      5. How to write a good CV      6. Don’ts of writing a CV   3. Job application letter      1. What to include      2. Addressing a cover letter      3. Signing off a cover letter   4. Portfolio of evidence      1. Academic credentials      2. Letters of commendations      3. Certification of participations      4. Awards and decorations   5. Interview skills      1. Listening skills      2. Grooming      3. Language command      4. Articulation of issues      5. Body language      6. Time management      7. Honesty   6. Generally knowledgeable in current affairs and technical area | * + Observation   + Oral assessment   + Portfolio of evidence   + Third party report * Written assessment |

**Suggested Methods Instruction**

* + Instructor-led facilitation using active learning strategies
  + Demonstration by trainer
  + Viewing of related videos
  + Group discussions
  + Role play
  + Case study

**Recommended resources for 30 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/specifications** | **Quantity** | **Recommended ratio (Item: trainee)** |
| **A** | **Learning materials** | | | |
|  | Textbooks | Comprehensive texts books on digital literacy | 5 pcs | 1:6 |
|  | Installation manuals | Detailed guides for equipment and software installation and troubleshooting | 5 pcs | 1:6 |
|  | PowerPoint presentations | For trainer’s use, covering course content and practical applications | 1 | 1:30 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:30 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:30 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:30 |
|  | Templates | Templates for creating various documents e.g. CV, Cover Letter, etc. | 30 | 1:1 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/theory room  /Learning resource  Area | Spacious, equipped with projectors and Seats for 30 trainees, approximately 45 sqm (5 m x 9 m) | 1 | 1:30 |
|  | Computer laboratory | Equipped with at least 30 functional computers with internet connectivity and the following software:   * + - Windows/ Linux/ macintosh operating system     - Microsoft office software     - Google workspace account     - Antivirus software | 1 | 1:30 |
|  |  |  |  |  |
| **C** | **Consumable materials** | | | |
|  | Printing papers | A4 and A3 printing papers suitable for the task | adequate |  |
|  | Whiteboard marker pens | Dry-erase markers for trainer’s use. Assorted colors | adequate |  |
|  | Storage devices | Any of the following storage devices:   * USB flash drive * USB hard drive * Compact disks (CDs) * Digital versatile disks (DVDs) | adequate |  |

## APPLY ENGINEERING MATHEMATICS

**UNIT CODE:** 0541 441 05A

**Relationship with Occupational Standards**

This unit addresses the Unit of Competency: Apply Mathematics

**Unit Duration: 150 Hours**

**Unit Description**

This unit describes the competences required in order to apply algebra, trigonometric and hyperbolic functions, coordinate geometry, statistics, vector theorem, matrices and to carry out mensuration.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| S/No | Learning Outcome | **Duration (Hrs.)** |
| 1 | Apply algebra | **20** |
| 2 | Apply trigonometric functions | **30** |
| 3 | Apply coordinate geometry | **20** |
| 4 | Carry out mensuration | **10** |
| 5 | Apply statistics | **30** |
| 6 | Apply vector theorem | **20** |
| 7 | Apply matrices | **20** |
|  | **TOTAL** | **150 HRS** |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply algebra | * 1. Indices      1. Power zero      2. Negative powers      3. Fractional powers      4. Laws of indices         1. Addition         2. Subtraction         3. Division         4. Multiplication   2. BODMAS   3. Roots      1. Square roots      2. Cube roots   4. Logarithms      1. Laws of logarithms         1. Product law         2. Quotient law         3. Power law   5. Use of scientific calculator      1. Power ON/OFF      2. Mode         1. Degree         2. Radian         3. Gradient         4. SD      3. Clear      4. Save   6. Simultaneous equations (2 equations)      1. Elimination      2. Substitution   7. Quadratic equations      1. Factorization      2. Quadratic formula | * Written tests |
| 1. Apply trigonometric functions | * 1. Angles      1. Acute      2. Obtuse      3. Reflex      4. Right angle   2. Triangles      1. Isosceles      2. Equilateral      3. Right angled      4. Scalene   3. Trigonometric ratios      1. Sine      2. Cosine      3. Tangent      4. Cosecant      5. Secant      6. Cotangent   4. Trigonometric identities      1. Proof of identities      2. Pythagorean identities   2.5 Solve trigonometric equations | * Written tests |
| 1. Apply coordinate geometry | * 1. Introduction to linear coordinates      1. Cartesian plane         1. x and y axes         2. Positive and negative coordinates      2. Gradient         1. Positive         2. Negative         3. Zero         4. Infinite         5. Gradients of parallel line         6. Gradients of perpendicular lines      3. y-intercept   2. Linear equations      1. Straight line      2. Parallel lines      3. Perpendicular lines   3. Graphs of linear equations      1. Straight line | * Written tests |
| 1. Carry out mensuration | * 1. Units and symbols of measurement      1. Mass      2. Distance      3. Speed      4. Temperature      5. Time   2. Imperial and metric units      1. Conversions   3. Perimeter      1. Regular shapes   4. Area      1. Regular shapes   5. Volume      1. Regular shapes | * Written tests |
| 1. Apply statistics and probability | * 1. Data presentation      1. Continuous variables         1. Histogram         2. Line      2. Discrete variable         1. Bar graph         2. Pie graph      3. Grouped data         1. Histogram         2. Bar         3. Cumulative frequency         4. ogive      4. Ungrouped data         1. Line         2. Cumulative frequency   2. Measures of central tendency      1. Mean         1. Grouped data         2. Ungrouped data      2. Mode         1. Grouped data         2. Ungrouped data      3. Medium         1. Grouped data         2. Ungrouped data   3. Measures of dispersion      1. Standard deviation         1. Grouped data         2. Ungrouped data      2. Variance         1. Grouped data         2. Ungrouped data   4. Probability      1. With replacement      2. Without replacement | * Written tests |
| 1. Apply vector theorem | * 1. Differentiate between vector and scalar quantities      1. Magnitude      2. Direction         1. Positive         2. Negative   2. Operation on vectors      1. Addition      2. Subtraction   3. Resolution of vectors      1. Analysis | * Written tests |
| 1. Apply matrices | * 1. Matrices      1. Types         1. Row         2. Column         3. Square         4. Zero         5. Identity         6. Diagonal   2. Matrices operations of a 2 x 2      1. Addition      2. Subtraction      3. Multiplication   3. Inverse of matrices of a 2 x 2      1. Determinant      2. Transpose      3. Adjoint      4. Inverse   4. Simultaneous equations of 2 equations      1. Inverse method | * Written tests |

**Suggested Delivery Methods**

* Demonstration
* Group discussions
* Online materials
* Direct instructions
* Simulation

**Recommended resources for 30 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning materials** | | | |
|  | Textbooks | Comprehensive textbooks on Engineering Mathematics | 5 Pcs | 1:6 |
|  | Graph books | For graphical representation of solutions | 30 | 1:1 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:30 |
|  | Computer | Functional desktop computer with online instructional content | 1 | 1:30 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:30 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:30 |
| **B** | **Learning facilities & infrastructure** | | | |
|  | Lecture/theory room | Spacious room with seats for 25 trainees, approximately 60 sqm | 1 | 1:30 |
| **C** | **Materials and supplies** | | | |
|  | First Aid kit | Fully equipped First Aid kit for use in case of accidents | 1 | 1:30 |
| **D** | **Tools and equipment** | | | |
|  | Set of mathematical instruments | For constructions and measurements | 30 | 1:1 |
|  | Scientific Calculator | For Calculations | 30 | 1:1 |
|  | Firefighting extinguishers | Water, carbon dioxide and chemical powder fire extinguishers for fire fighting | 1 | 1:30 |
| **E** | **Reference materials** | | | |
|  | Training presentations/slides | Digital format for shared access among trainees | 1 | 1:30 |
|  | Standard mathematical tables | For reference on formulae, identities, laws and principles | 30 | 1:1 |

## INDUSTRIAL AUTOMATION ELECTRICAL SYSTEMS INSTALLATION AND MAINTAINANCE

**UNIT CODE:** 0714 451 09A

**Relationship to occupational standards**

This unit addresses the unit of competency: Install and Maintain Industrial Automation Electrical Systems

**Duration of unit: 170 hours**

**Unit description**

This unit covers the competencies required in installation of an industrial automation and robotics electrical systems according to the system design considerations. It involves conducting industrial automation electrical system site survey, planning industrial automation electrical system installation, installing industrial automation electrical system and maintaining industrial automation electrical system.

**Summary of learning outcomes**

By the end of this unit of learning, the trainee will be able to;

|  |  |  |
| --- | --- | --- |
| S/No | Learning Outcome | **Duration (Hrs.)** |
| 1 | Conduct industrial automation electrical system site survey. | **30** |
| 2 | Plan industrial automation electrical system installation | **50** |
| 3 | Install industrial automation electrical system | **50** |
| 4 | Maintain industrial automation electrical system | **40** |
|  | **TOTAL** | **170 HRS** |

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Conduct industrial automation electrical system site survey | * 1. Site survey aspects      1. Phase requirement analysis, voltage and power factor needs, electrical protection.      2. Environmental considerations, cable routing, redundancy, and scalability.      3. Instrumentation systems and compatibility with existing systems.   2. Tools and equipment for site survey      1. Classification of tools      2. Uses of tools      3. Operations of tools.      4. Maintenance and care of tools.   3. Practice: site visit survey   4. Report writing      1. Structure of site survey report.      2. Procedures and standards for documentation. | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |
| 1. Plan industrial automation electrical system installation | * 1. Introduction to industrial automation      1. Overview of industrial automation      2. Definition and significance      3. Key components and technologies   2. Types of automation systems      1. Fixed vs. flexible automation      2. Continuous vs. batch processes   3. Electrical fundamentals      1. Basic electrical concepts      2. Voltage, current, resistance, and power      3. Ohm’s law and electrical circuits   4. Electrical components      1. Resistors, capacitors, inductors      2. Switches, relays, and contactors   5. AC vs. DC Systems      1. Characteristics and applications   6. Control systems and components      1. Introduction to control systems      2. Types of control systems: open-loop vs. closed-loop      3. Programmable Logic Controllers (PLCs)   7. Sensors and actuators      1. Types of sensors (proximity, photoelectric)      2. Types of actuators (motors, valves)   8. Human-Machine Interface (HMI)      1. Basics of HMI design and implementation   9. Designing installation      1. Electrical design principles         1. Load balancing         2. Redundancy         3. Safety.      2. Equipment and System layout planning.   10. Work plan preparation       1. Scheduling       2. Resources estimation       3. Safety plans       4. Task assignments.   11. Electrical system supplies       1. Overview of electrical supplies          1. Motors          2. Drives          3. Generators          4. Switchgear          5. Distribution panel          6. Control panels       2. Working principles of electrical supplies.          1. Cables          2. Protection devices and switchgear          3. Distribution board          4. Lighting fixtures          5. Enclosures          6. Earthing rods, clamps          7. Electrical tools and equipment          8. Connectors and terminals          9. Conduits          10. Raceways          11. Fasteners   12. Practice: Plan industrial automation electrical system | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |
| 1. Install industrial automation electrical system | * 1. Personal Protective Equipment (PPE)      1. Uses and importance of PPE         1. Helmets         2. gloves,         3. Safety goggles.   2. Structured Wiring      1. Techniques of wiring diagrams and structured cabling.      2. Laying cables, routing through conduits, raceways.   3. Operation and specifications of accessories and equipment      1. Accessories         1. Terminal blocks         2. Switches         3. Sockets         4. Push buttons         5. Safety interlocks         6. Relays      2. Equipment         1. Motors         2. Drives         3. Generators         4. Switchgear         5. Distribution panel         6. Control panels   4. Wire Termination      1. Techniques for wire Termination         1. Wire cutting         2. Stripping         3. Connecting.   5. Testing electrical systems      1. Continuity tests      2. Insulation resistance tests      3. Phase sequence      4. Functionality tests   6. Housekeeping and waste disposal      1. Procedures for maintaining a clean installation site and managing waste.   7. Practice: Install industrial automation electrical system | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |
| 1. Maintain industrial automation electrical system | * 1. Maintenance scheduling      1. Development and implementation of regular maintenance schedules.      2. Tracking maintenance logs and reporting.   2. Maintenance tools and equipment usage:      1. Tools         1. Tape measure         2. Laser meter         3. Camera         4. Multimeters         5. Stationery         6. Infrared thermometer         7. Cable tracer         8. Ladder         9. Flashlight      2. Equipment         1. Power analyser         2. Megohmmeter         3. Oscilloscope   3. Carry out maintenance tasks      1. Inspection routines      2. Testing      3. Cleaning      4. Tightening      5. Lubrication.      6. Troubleshoot and replace defective components.   4. Practice: Maintain industrial automation electrical system | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Online videos
* Power point presentation

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** | | | |
|  | Textbooks | Comprehensive texts on electrical systems and automation | 10 pcs | 2:5 |
|  | Installation Manuals | Detailed guides for equipment installation and troubleshooting | 5 pcs | 1:5 |
|  | Charts | Visual aids covering electrical theories and safety protocols | 10 pcs | 2:5 |
|  | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | Adequate |  |
|  |  |  |  |  |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Spacious, equipped with projectors and seating for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Hands-on training area with workbenches, tools, and safety equipment, approximately 80 sqm | 1 | 1:25 |
|  | Laboratory | Equipped with testing setups for electrical experiments, approximately 50 sqm | 1 | 1:25 |
|  |  |  |  |  |
| **C** | **Consumable Materials** | | | |
|  | Electrical Wires | Assorted sizes and color-coded (e.g., 1.5mm², 2.5mm², 4mm²) | Adequate |  |
|  | Insulation Tapes | For securing connections and insulation, assorted colors | Adequate |  |
|  |  |  |  |  |
| **D** | **Tools and Equipment** | | | |
|  | Tape Measures | 5m tape measures for accurate measurement | 5pcs | 1:5 |
|  | Laser Meters | For precise distance measurements, shared among trainees | 5pcs | 1:5 |
|  | Multimeters | Digital multimeters for voltage, current, and resistance measurements | 5 pcs | 1:5 |
|  | Cable Tracers | For tracing cable paths and identifying faults | 5 pcs | 1:5 |
|  | Infrared Thermometers | For non-contact temperature measurements, shared among trainees | 5 pcs | 1:5 |
|  | Ladders (4-6 ft) | For reaching elevated areas during practical training | 5 pcs | 1:5 |
|  | Flashlights | Portable flashlights for visibility during hands-on work | 5 pcs | 1:5 |
|  | Megohmmeters | For insulation resistance testing, shared among trainees | 2 pcs | 2:25 |
|  | Power Analyzers | For analyzing power quality, shared among trainees | 5 pcs | 1:5 |
|  | Basic Hand Tools | Sets including screwdrivers, pliers, and cutters | 25 sets | 1:1 |
|  | Clamp Meters | For measuring current flow in circuits, shared among trainees | 5 pcs | 1:5 |
|  | Thermal Imaging Cameras | For detecting heat patterns in electrical systems, shared among trainees | 1 pc | 1:25 |
|  | Controllers | For controlling electrical systems | 5 | 1:5 |
|  |  |  |  |  |
| **E** | **PPE (Personal Protective Equipment)** | | | |
|  | PPE Sets | For personal protection | 25 sets | 1:1 |
|  | Safety Signs and Barriers | For simulating safety zones and hazards | Adequate |  |
|  | Earthing Test Kits | For ground testing and demonstrating earthing procedures | 5 pcs | 1:5 |
|  | Electrical Test Benches | For hands-on testing of functionality and circuit design | 5 pcs | 1:5 |
|  |  |  |  |  |
| **F** | **Reference Materials** | | | |
|  | Industrial Automation Manuals | Covering principles and practices in automation | 5 pcs | 1:5 |
|  | Electrical Standards | Reference on industry standards (e.g., IEEE Guidelines) | 5 pcs | 1:5 |
|  | Technical Handbooks On motors, drives, and wiring systems | Reference | 5 pcs | 1:5 |
|  | Multimedia Learning Modules | Digital licenses for videos and tutorials | 1 License | 1:1 |
|  | Practical Assessment Guides | Worksheets for practical assessments | 5 pcs | 1:5 |

MODULE FOUR

## STANDALONE CONTROL SYSTEMS INSTALLATION AND MAINTENANCE

**UNIT CODE:** 0714 451 10A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Install and Maintain Stand-Alone Controlled Systems

**Duration of Unit:** 200 hours.

**Unit Description**

This unit covers the competencies required in installation and maintenance of stand-alone control system. These competencies include; conducting stand-alone system control site survey, planning stand-alone control system installation, installing stand-alone control system and maintaining stand-alone control system.

**Summary of Learning Outcomes**

By the end of the unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcome** | **Duration (Hrs.)** |
| 1 | Conduct stand-alone control system site survey | **30** |
| 2 | Plan stand-alone control system installation | **50** |
| 3 | Install stand-alone control systems | **70** |
| 4 | Maintain stand-alone control systems | **50** |
|  | **TOTAL** | **200 HRS** |

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Conduct stand-alone control system site survey | * 1. Standalone Controllers      1. Programmable Logic Controllers (PLCs)      2. Supervisory Control and Data Acquisition (SCADA)      3. Distributed Control System (DCS).      4. PIDs      5. Microcontroller      6. Digital signal processors      7. Motor controllers      8. Power inverters   2. Site Survey Aspects Considerations      1. Power requirements      2. User requirements      3. Environmental considerations      4. Cable routes      5. Instrumentation systems      6. Compatibility with existing systems      7. Scalability      8. Cost   3. Site Assessment      1. Structural integrity, and environmental factors (temperature, humidity).      2. Utilities (power, networking, ventilation).   4. Safety and Compliance      1. Safety regulations and standards (e.g., OSHA, ISO).      2. Hazard prevention (such as emergency stops and barriers).   5. Infrastructure Preparation      1. Power supply and cabling      2. Communication and data networks (wired/wireless).      3. Lighting, ventilation, and flooring.   6. Mounting and Support Structures      1. Mounting platforms, frames, or rails for SAC.   7. Environmental Controls      1. Temperature, humidity, and dust control needs.      2. Airflow and ventilation for robotic operation.   8. SAC Access and Space Management      1. Clearances and pathways for SAC, maintenance, and operator access.   9. Applications of tools and equipment.      1. Tools         1. Tape measure         2. Laser meter         3. Camera         4. Multimeter         5. Stationery         6. Infrared thermometer         7. Cable tracer         8. Ladder         9. Flashlight      2. Equipment         1. Power analyser         2. Megohmmeter         3. Personal computer   10. Site survey report documentation. | * Oral assessment * Portfolio of evidence * Interviews * Third party report * Written assessment * Practical assessment * Projects |
| 1. Plan stand-alone control system installation | 1. Definition and Applications    * 1. Overview of stand-alone controlled systems      2. Common applications in various industries (manufacturing, robotics, HVAC, etc.) 2. System Components    * 1. Sensors, actuators, controllers, and interfaces      2. Overview of system architecture 3. Precautions during installation of Stand- alone Control System. 4. Safety measurers undertaken during workplan.    * 1. specifications of Stand-alone control supplies      2. Cables      3. Protection devices and switchgear      4. Distribution board      5. Lighting fixtures      6. Enclosures      7. Earthing rods, clamps      8. Installation Tools and equipment      9. Connectors and terminals      10. Conduits      11. Raceways      12. Fasteners    1. Practice: Plan Stand- alone control system | * Oral assessment * Portfolio of evidence * Interviews * Third party report * Written assessment * Practical assessment * Projects |
| 1. Install Stand-alone control systems | * 1. Structured wiring      1. Cable routing      2. Cable laying      3. Cable labelling   2. Stand-alone control system accessories and equipment      1. Classifications of Tools and Accessories.      2. Uses of Tools and Accessories.      3. Operations of Tools and Accessories.   3. Ways of terminating Stand-alone Control System.   4. Tests carried out in Stand-alone control system.   5. Standalone controller Programming      1. Objective definition, (Task identification and performance criteria.)      2. System flow chart.      3. Control Algorithms      4. Coding.      5. Testing and Debugging program      6. System simulation      7. Field Testing      8. Code, algorithm documentation, and user manuals.   6. Housekeeping procedure carried out in a workplace.   7. Ways of disposing site waste in a workplace   8. Practice: Install Stand- alone control system | * Oral assessment * Portfolio of evidence * Interviews * Third party report * Written assessment * Practical assessment * Projects |
| 1. Maintain Stand-alone control systems | * 1. Standalone Controller Maintenance Schedule      1. Factors to consider while designing a Maintenance Schedule.   2. Importance of PPE in a workplace.   3. Ways of handling and maintaining Tools and Accessories.   4. Tasks carried out in Stand- alone control system maintenance.   5. Stand-alone report.   6. Practice: Maintain Stand- alone control system | * Oral assessment * Portfolio of evidence * Interviews * Third party report * Written assessment * Practical assessment * Projects |

**Suggested delivery methods**

* Group discussions
* Demonstration by trainer
* Online videos
* Power point presentation

**Recommended Resources**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Tools** |  |  |  |
|  | Multimeters | Digital multimeters for measuring voltage, current, and resistance | 25 pcs | 1:1 |
|  | Clamp Meters | For measuring current flow in electrical systems | 5 pcs | 1:5 |
|  | Power Analyzers | For analyzing power quality and consumption | 5 pcs | 1:5 |
|  | Sensors | Assorted sensors | 5 pcs | 1:5 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Approximately 80 sqm | 1 | 1:25 |
|  | Laboratory | Approximately 80 sqm | 1 | 1:25 |
| **C** | **Hand Tools** | | | |
|  | Wrenches | Adjustable wrenches for various sizes of nuts and bolts | 4 pcs | 4:25 |
|  | Screwdrivers | Phillips and flathead screwdrivers for assembly work | 5 pcs | 1:5 |
|  | Pliers | For gripping, twisting, and cutting wires | 5 pcs | 1:5 |
|  | Hex Keys | Allen wrenches for hexagonal screws and bolts | 5 pcs | 1:5 |
|  | Cutters | Wire cutters for precise cutting of electrical wires | 5 pcs | 1:5 |
| **D** | **Measuring Tools** | | | |
|  | Tape Measures | 5m tape measures for accurate measurements | 5 pcs | 1:5 |
|  | Calipers | For measuring internal and external dimensions precisely | 5 pcs | 1:5 |
|  | Alignment Tools | Assorted | 5 pcs | 1:5 |
|  |  |  |  |  |
| **E** | **Materials and Supplies** | | | |
|  | Manipulators | For robotic manipulation tasks | 2 pcs | 2:25 |
|  | Controller Units | For controlling robotic systems | 2 pcs | 2:25 |
|  | Sensors | Various sensors for feedback and measurement | 2 pcs | 2:25 |
|  | Actuators | For converting electrical signals into mechanical motion | 2 pcs | 2:25 |
|  | Encoders | For position sensing in robotic systems | 2 pcs | 2:25 |
|  | Gears | For mechanical transmission in robotics | 2 pcs | 2:25 |
|  | Motors | Includes servo motors, stepper motors, and linear motors | 2 pcs | 2:25 |
|  |  |  |  |  |
| **F** | **Equipment** | | | |
|  | *Safety Equipment* |  |  |  |
|  | Safety Glasses | For eye protection during practical activities | 25 pcs | 1:1 |
|  | Gloves | For hand protection while working with machinery | 25 pairs | 1:1 |
|  | Hearing Protection | Ear protection to prevent noise-related injuries | 25 pcs | 1:1 |
|  | Hard Hats | Head protection for safety during hands-on work | 25 pcs | 1:1 |
|  | *Testing Equipment* |  |  |  |
|  | Oscilloscopes | For visualizing electrical signals | 2 pcs | 2:25 |
|  | Megohmmeters | For insulation resistance testing | 2 pcs | 2:25 |
|  | *Miscellaneous* |  |  |  |
|  | Lubricating Equipment | For maintenance of mechanical systems | 1 set |  |
|  | Vacuum Pump | For testing and cooling applications | 1 unit |  |
|  | Megohmmeter | For additional insulation testing | 1 unit |  |
|  |  |  |  |  |
| **G** | **Reference Materials** | | | |
|  | Component and Equipment Manuals | Detailed manuals for operation and maintenance | Adequate |  |
|  | Robotic Installation Books | Texts covering the principles and practices of robotic systems | Adequate |  |
|  | Other Reference Materials | Journals, past papers, and online resources for further learning | Adequate |  |

## PNEUMATIC SYSTEM INSTALLATION AND MAINTENANCE

**UNIT CODE:** 0714 451 11A

**Relationship to occupational standards**

This unit addresses the unit of competency: Install and maintain pneumatic systems

**Duration of unit:** 220 hours.

**Unit description**

This unit covers the competencies required in installation and maintenance of pneumatic systems. These competencies include; applying knowledge of perfect gases, operating air compressors, conducting pneumatic system site survey, planning pneumatic system installation and installing pneumatic system and maintaining pneumatic systems.

**Summary of learning outcomes**

By the end of the unit of learning, the trainee will be able to;

|  |  |  |
| --- | --- | --- |
| S/No | Learning Outcome | **Duration (Hrs.)** |
| 1 | Apply knowledge of perfect gases | **10** |
| 2 | Operate air compressors | **10** |
| 3 | Conduct pneumatic system site survey | **30** |
| 4 | Plan pneumatic system installation | **50** |
| 5 | Install pneumatic systems | **70** |
| 6 | Maintain pneumatic systems | **50** |
|  | **TOTAL** | **220 HRS** |

**Learning outcomes, content and suggested assessment methods**

| **Learning outcome** | **Content** | **Suggested assessment methods** |
| --- | --- | --- |
| 1. Apply knowledge of perfect gases | * 1. Laws of perfect gases      1. Boyle's law      2. Charles' law      3. Gay-Lussac law      4. Joule's law      5. Avogadro's law   2. General gas equation      1. Derive and apply general gas equation PV=mRT   3. Characteristic equation of gas      1. Application in engineering calculations   4. Universal gas constant      1. Define universal gas constant      2. Apply universal gas constant equation in engineering calculation   5. Specific heat      1. Constant volume      2. Constant pressure | * Written tests |
| 1. Operate air compressors | * 1. Classification of air compressors      1. According to working      2. According to action      3. According to number of stages   2. Single stage reciprocating air compressor      1. Work done by a single stage reciprocating air compressor without clearance volume   3. Work done during      1. isothermal compression      2. polytropic compression (PVn = Constant)      3. isentropic compression   4. Power required to drive a single-stage reciprocating air compressor      1. Calculations   5. Work-done by reciprocating air compressor with clearance volume      1. Calculations      2. Determine multistage compression   6. Power required to drive a two-stage reciprocating air compressor   7. Minimum work required for a two-stage reciprocating air compressor | * Written tests |
| 1. Conduct pneumatic system site survey | * 1. Identifying site survey aspects.      1. User requirements      2. System requirements.      3. Space and layout considerations.      4. Environmental conditions      5. Safety regulations and standards.      6. Air quality assessment.      7. Compatibility with existing systems   2. Assembling site survey tools and equipment      1. Classification of tools and equipment      2. Uses of tools and equipment   3. Performing the site survey      1. Conducting measurements and evaluations.      2. Documenting site conditions   4. Generating the site survey report      1. Compiling findings.      2. Presenting data according to workplace procedures | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |
| 1. Plan pneumatic system installation | * 1. Pneumatic system design      1. Pneumatic system components. * Compressors, valves, actuators, and filters * Types of pneumatic cylinders (single-acting, double-acting)   + 1. System design * Circuit design principles * Sizing and selecting components   + 1. Factors to consider while designing Pneumatic system layout.     2. Design of Pneumatic system layout.   1. Operation and Control      1. System Operation * Basics of pneumatic control * Flow control and pressure regulation   + 1. Automation in pneumatics * Introduction to electronic controls * Integration with PLCs and other control systems   1. Pneumatic system installation workplan      1. Pre-installation planning   (objectives, scope, timeline, and assign roles)   * + 1. Site preparation     2. Delivery & inspection     3. Mechanical installation     4. Electrical installation     5. Software installation & configuration     6. I/O and communication testing   1. Pneumatic system supplies      1. Types of pneumatic system supplies * Pressure gauges * Vacuum gauges * Pressure regulators * Pipes and tubes * Connectors * Air compressors * Control valves * Dryers * Pneumatic system reservoir * Enclosures * Fittings * Safety valves   + 1. Interpretation of pneumatic system design symbols.     2. Uses of pneumatic system supplies.     3. Safety precautions to undertake while handling pneumatic system supplies.   1. Practice: Plan pneumatic system installation | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |
| 1. Install pneumatic system | * 1. PPE      1. Types of PPE.   • Helmet  • Hand gloves  • Safety shoes  • Harness  • Safety goggles   * + 1. Uses of PPE   1. Pneumatic system piping installation.      1. Types of joints.      2. Pneumatic system fittings      3. Tools and equipment.      4. Interpretation of installation layout.   2. Mounting pneumatic system accessories and equipment      1. Accessories         1. Couplers         2. Check valves         3. Flow meters         4. Pressure gauges         5. Installation valves      2. Equipment         1. Pneumatic valves         2. Pneumatic cylinders         3. Compressors         4. Pneumatic pumps         5. Positioners   3. Pneumatic system test      1. Functionality test      2. Leakage test      3. Pressure test      4. Air quality test      5. Flow rate test   4. Calibration of pneumatic control      1. System parameters      2. Pneumatic system accessories Calibration against system parameters.         1. Control valve         2. Pressure gauges         3. Flow metres   5. House Keeping and waste disposal   6. Practice: Install pneumatic system installation | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |
| 1. Maintain pneumatic systems | * 1. Pneumatic system maintenance      1. maintaining pneumatic system.   2. PPE Usage      1. Helmet      2. Hand gloves      3. Safety shoes      4. Harness      5. Safety goggles   3. Uses of pneumatic system maintenance tools, equipment and spares      1. Tools         1. Tape measure         2. Laser distance meter         3. Camera         4. Flow meters         5. Pressure gauges         6. Stationery         7. Infrared thermometer         8. Ladder         9. Flashlight         10. Leakage testers         11. Hand tools      2. Equipment         1. Air analyzers         2. Ladder   4. Pneumatic system maintenance tasks * Inspection * Testing and measurements * Air quality check * Pressure check * Cleaning * Tightening * Replacing components * Replacing consumables   1. Maintenance report   2. Practice      1. Hands-on Installation and Maintenance      2. Practical exercises in installing pneumatic systems      3. Simulated troubleshooting scenarios   3. Project Work      1. Group projects on designing and implementing a pneumatic system      2. Presentation of project outcomes and experiences | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |

**Suggested delivery methods**

* Group discussions
* Demonstration by trainer
* Online videos
* Power point presentation

**Recommended resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/item** | **Description/specifications** | **Quantity** | **Recommended ratio (item: trainee)** |
| **A** | **Tools** | | | |
|  | Multimeters | For measuring voltage, current, and resistance | 25 pcs | 1:1 |
|  | Clamp meters | For measuring electrical current | 5 pcs | 1:5 |
|  | Power analyzers | For analyzing power quality and consumption | 5 pcs | 1:5 |
|  | Thermal imaging cameras | For visualizing heat patterns and identifying issues | 5 pcs | 1:5 |
|  | Wrenches | For tightening and loosening fasteners | 4 pcs | 4:25 |
|  | Screwdrivers | For driving screws; various types included | 5 pcs | 1:5 |
|  | Pliers | For gripping and bending wires | 5 pcs | 1:5 |
|  | Hex Keys | For hexagonal screws and bolts | 5 pcs | 1:5 |
|  | Cutters | For cutting wires and cables | 5 pcs | 1:5 |
|  | Tape measures | For measuring lengths and distances | 5 pcs | 1:5 |
|  | Calipers | For measuring internal and external dimensions | 5 pcs | 1:5 |
|  | Alignment lasers | For precise alignment of components | 2 pcs | 2:25 |
|  | Plumb bobs | For vertical alignment in installations | 5 pcs | 1:5 |
| **B** | **Learning facilities & infrastructure** | | | |
|  | Lecture/theory room | Approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Approximately 80 sqm | 1 | 1:25 |
|  | Laboratory | Approximately 80 sqm | 1 | 1:25 |
|  |  |  |  |  |
| **C** | **Materials and supplies** | | | |
|  | Pressure gauges | For measuring pressure in pneumatic systems | 25 pcs | 1:1 |
|  | Vacuum gauges | For measuring vacuum levels in systems | 25 pcs | 1:1 |
|  | Pressure regulators | For controlling and regulating pressure | 25 pcs | 1:1 |
|  | Pipes and tubes | For various pneumatic and hydraulic applications | 100 pcs | 4:1 |
|  | Connectors | For connecting pipes and tubes | 100 pcs | 4:1 |
|  | Air compressors | For supplying compressed air for pneumatic tools | 25 pcs | 1:1 |
|  | Valves | For controlling the flow of fluids in systems | 25 pcs | 1:1 |
|  | Enclosures | For housing electrical and mechanical components | 25 pcs | 1:1 |
|  | Fittings | For connecting different sections of pipes and tubes | 25 pcs | 1:1 |
|  | Safety valves | For ensuring safety in pressure systems | 25 pcs | 1:1 |
|  | Pneumatic cylinders | Single/ double | 10 pcs | 2:25 |
|  | Sensors | Assorted | 10 pcs | 2:25 |
|  | Controllers | Controlling automatic pneumatics system | 5 pcs | 1:5 |
|  |  |  |  |  |
| **D** | **Equipment** | | | |
|  | Safety glasses | Eye protection for all trainees | 25 pcs | 1:1 |
|  | Gloves | Hand protection during training and operations | 25 pairs | 1:1 |
|  | Hearing protection | To safeguard against loud noises | 25 pcs | 1:1 |
|  | Hard hats | Head protection while working | 25 pcs | 1:1 |
|  | Oscilloscopes | For visualizing electrical signals | 2 units | 2:25 |
|  | Megohmmeters | For testing insulation resistance | 5 units | 1:5 |
|  |  |  |  |  |
| **E** | **Miscellaneous** | | | |
|  | Lubricating equipment | For maintaining smooth operation of mechanical components | 1 unit | 1:25 |
|  | Vacuum pump | For creating a vacuum for testing and operations | 1 unit | 1:25 |
|  |  |  |  |  |
| **F** | **Reference materials** | | | |
|  | Component and equipment manuals | Comprehensive guides on all tools and equipment | Adequate |  |
|  | Pneumatic system installation manuals | For proper setup and maintenance of pneumatic systems | Adequate |  |
|  | Other reference materials | Journals, past papers, and online resources for further study | Adequate |  |

MODULE FIVE

## COMMUNICATION SKILLS

**UNIT CODE:** 0031 441 02A

**Relationship with occupational standards**

This unit addresses the unit of competency: apply communication skills

**Duration of unit:** **40 Hours**

**Unit description**

This unit covers the competencies required to apply communication skills. It involves applying communication channels, written, non-verbal, oral, and group communication skills.

**Summary of learning outcomes**

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcome** | **Duration (Hrs.)** |
| 1 | Apply communication channels. | 10 |
| 2 | Apply written communication skills. | 12 |
| 3 | Apply non-verbal skills. | 4 |
| 4 | Apply oral communication skills. | 4 |
| 5 | Apply group communication skills. | 10 |
|  | **TOTAL** | **40 HRS** |

**Learning outcomes, content, and suggested assessment methods**

| **Learning outcome** | **Content** | **Suggested assessment methods** |
| --- | --- | --- |
| 1. Apply communication channels | * 1. Communication process   2. Principles of effective communication   3. Channels/medium/modes of communication   4. Factors to consider when selecting a channel of communication   5. Barriers to effective communication   6. Flow/patterns of communication   7. Sources of information   8. Organizational policies | * Oral questions * Written assessment * Observation * Portfolio of evidence * Practical assessment * Third party report |
| 1. Apply written communication skills | * 1. Types of written communication   2. Elements of communication   3. Organization requirements for written communication | * Oral assessment * Written assessment * Observation * Portfolio of evidence * Practical assessment * Third party report |
| 1. Apply non-verbal communication skills | * 1. Utilize body language and gestures   2. Apply body posture   3. Apply workplace dressing code | * Oral assessment * Written assessment * Observation * Portfolio of evidence * Practical assessment * Third party report |
| 1. Apply oral communication skills | * 1. Types of oral communication pathways   2. Effective questioning techniques   3. Workplace etiquette   4. Active listening | * Oral assessment * Written assessment * Observation * Portfolio of evidence * Practical assessment * Third party report |
| 1. Apply group discussion skills | * 1. Establishing rapport      1. Facilitating resolution of issues      2. Developing action plans      3. Group organization techniques      4. Turn-taking techniques      5. Conflict resolution techniques      6. Team-work | * Oral assessment * Written assessment * Observation * Portfolio of evidence * Practical assessment |

**Suggested methods of instruction**

* Discussion
* Roleplaying
* Simulation
* Direct instruction
* Demonstration
* Field trips

**Recommended resources for 30 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/item** | **Description/specifications** | **Quantity** | **Recommended ratio (item: trainee)** |
| **A** | **Learning materials** | | | |
|  | Textbooks | Comprehensive texts books on communication skills | 30 pcs | 1:1 |
|  | Mobile phones | Smartphone for use by trainees | 30 pcs | 1:1 |
|  | Internet connection | Internet connection to aid communication between trainees |  |  |
|  | PowerPoint presentations | For trainer’s use, covering course content and practical applications | 1 | 1:30 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:30 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:30 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:30 |
|  | Templates | Templates for creating various documents e.g. CV, Cover Letter, minutes, reports etc. | 30 | 1:1 |
| **B** | **Learning facilities & infrastructure** | | | |
|  | Lecture/theory room  /Learning resource  Area | Spacious, equipped with projectors and seats for 30 trainees, approximately 45 sqm (5 m x 9 m) | 1 | 1:30 |
|  | Computer laboratory | Equipped with at least 30 functional computers with internet connectivity and the following software:   * + - Windows/ Linux/ macintosh operating system     - Microsoft office software     - Google workspace account     - Antivirus software | 30 | 1:1 |
|  |  |  |  |  |
| **C** | **Consumable Materials** | | | |
|  | Printing papers | A4 and A3 printing papers suitable for the task | Adequate |  |
|  | Flashcards | For carrying out various activities by trainees | Adequate |  |
|  | Flipcharts | Sufficient for group work activities and displaying | Adequate |  |
|  | Whiteboard marker pens | Dry-erase markers for trainer’s use. Assorted colors | Adequate |  |

## WORK ETHICS AND PRACTICES

**UNIT CODE:** 0417 441 03A

**Relationship with Occupational Standards**

This unit addresses the Unit of Competency: Apply work ethics and practices.

**Duration of Unit: 40 Hours**

**Unit Description**

This unit covers competencies required to demonstrate employability skills. It involves the ability to: conduct self-management, promote ethical work practices and values, promote teamwork, manage workplace conflicts, maintain professional and personal development, apply problem-solving, and promote customer care.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcome** | **Duration (Hrs.)** |
| 1 | Apply self-management skills | 10 |
| 2 | Promote ethical practices and values | 4 |
| 3 | Promote teamwork | 10 |
| 4 | Maintain professional and personal development | 10 |
| 5 | Apply problem-solving skills | 4 |
| 6 | Promote customer care. | 2 |
|  | **TOTAL HOURS** | **40** |

**Learning Outcomes, Content, and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply self-management skills | * 1. Self-awareness   2. Formulating personal vision, mission, and goals   3. Healthy lifestyle practices   4. Strategies for overcoming work challenges   5. Emotional intelligence   6. Coping with Work Stress.   7. Assertiveness versus aggressiveness and passiveness      1. Developing and maintaining high self-esteem      2. Developing and maintaining positive self-image      3. Time management      4. Setting performance targets      5. Monitoring and evaluating performance targets | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |
| 1. Promote ethical work practices and values | * 1. Integrity   2. Core Values, ethics and beliefs   3. Patriotism   4. Professionalism   5. Organizational codes of conduct   6. Industry policies and procedures | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |
| 1. Promote Teamwork | * 1. Types of teams   2. Team building      1. Individual responsibilities in a team      2. Determination of team roles and objectives      3. Team parameters and relationships      4. Benefits of teamwork      5. Qualities of a team player      6. Leading a team      7. Team performance and evaluation   3. Conflicts and conflict resolution   4. Gender and diversity mainstreaming   5. Developing Healthy workplace relationships   6. Adaptability and flexibility   7. Coaching and mentoring skills | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |
| 1. Maintain professional and personal development | * 1. Personal vs professional development and growth   2. Avenues for professional growth   3. Recognizing career advancement   4. Training and career opportunities      1. Assessing training needs      2. Mobilizing training resources   5. Licenses and certifications for professional growth and development   6. Pursuing personal and organizational goals   7. Managing work priorities and commitments   8. Dynamism and on-the-job learning | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |
| 1. Apply Problem-solving skills | * 1. Causes of problems   2. Methods of solving problems   3. Problem-solving process   4. Decision making   5. Creative thinking and critical thinking process in development of innovative and practical solutions | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |
| 1. Promote Customer Care | * 1. Identifying customer needs   2. Qualities of good customer service   3. Customer feedback methods   4. Resolving customer concerns   5. Customer outreach programs   6. Customer retention | * Observation * Written assessment * Oral assessment * Third party reports * Portfolio of evidence * Project * Practical |

**Suggested Methods of Instruction**

* Instructor lead facilitation of theory using active learning strategies.
* Demonstrations
* Simulation/Role play
* Group Discussion
* Presentations
* Projects
* Case studies
* Assignments

**Recommended Resources for 30 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
|  | Textbooks | Comprehensive texts books on Work Ethics and Practices | 30 pcs | 1:1 |
|  | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:30 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:30 |
|  | Media Resources | This include but are not limited to:   * Video Clips * Audio Clips * TV Sets * Radio Sets |  |  |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:30 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
|  | Lecture/Theory Room  /Learning Resource  Area\* | Spacious, equipped with projectors and Seats for 30 trainees, approximately 45 sqm (5 m x 9 m) | 1 | 1:30 |
|  | Computer Laboratory | Equipped with at least 30 functional computers with internet connectivity and the following software:   * + - Windows/ Linux/ Macintosh Operating System     - Microsoft Office Software     - Google Workspace Account     - Antivirus Software | 30 | 1:1 |
|  |  |  |  |  |
| **C** | **Consumable Materials** |  |  |  |
|  | Printing Papers | A4 and A3 Printing papers suitable for the task | Enough |  |
|  | Flashcards | For carrying out various activities by trainees | Enough |  |
|  | Charts | Sufficient for group work activities and displaying | Enough |  |
|  | Whiteboard Marker Pens | Dry-erase markers for trainer’s use. Assorted colors | Enough |  |

## ENTREPRENEURIAL SKILLS

**UNIT CODE:0413 441 04A**

**Relationship with occupational standards**

This unit addresses the unit of competency: Apply Entrepreneurial skills.

**Duration of unit: 40 Hours**

**Unit Description:**

This unit covers the competencies required to demonstrate an understanding of entrepreneurship. It involves demonstrating an understanding of financial literacy, applying entrepreneurial concepts identifying entrepreneurship opportunities, applying business legal aspects, and developing business innovative strategies and business plans.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcome** | **Duration (Hrs.)** |
| 1 | Apply financial literacy | 6 |
| 2 | Apply the entrepreneurial concept | 4 |
| 3 | Identify entrepreneurship opportunities | 6 |
| 4 | Apply business legal aspects | 6 |
| 5 | Innovate Business Strategies | 6 |
| 6 | Develop business plan | 12 |
|  | **TOTAL HOURS** | **40** |

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply financial literacy | * 1. Personal finance management   2. Balancing between needs and wants   3. Budget Preparation   4. Saving management   5. Factors to consider when deciding where to save   6. Debt management   7. Factors to consider before taking a loan   8. Investment decisions   9. Types of investments   10. Factors to consider when investing money   11. Insurance services   12. insurance products available in the market   13. Insurable risks | * Observation * Project * Written assessment * Oral assessment * Third party report * Interviews |
| 1. Apply entrepreneurial concept | * 1. Difference between Entrepreneurs and Business persons   2. Types of entrepreneurs   3. Ways of becoming an entrepreneur   4. Characteristics of Entrepreneurs   5. salaried employment and self-employment   6. Requirements for entry into self-employment   7. Roles of an Entrepreneur in an enterprise   8. Contributions of Entrepreneurship | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 1. Identify entrepreneurship opportunities | * 1. Sources of business ideas   2. Factors to consider when evaluating business opportunity   3. Business life cycle | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 1. Apply business legal aspects | * 1. Forms of business ownership   2. Business registration and licensing processing   3. Types of contracts and agreements   4. Employment laws   5. Taxation laws | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 1. Innovate business Strategies | * 1. Creativity in business   2. Innovative business strategies   3. Entrepreneurial Linkages   4. ICT in business growth and development | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 1. Develop Business Plan | * 1. Business description   2. Marketing plan   3. Organizational/Management   4. plan   5. Production/operation plan   6. Financial plan   7. Executive summary   8. Business plan presentation   9. Business idea incubation | * Observation * Written assessment * Project * Oral assessment * Third party report |

**Suggested Methods of Instruction**

* Direct instruction with active learning strategies
* Project (Business plan)
* Case studies
* Field trips
* Group Discussions
* Demonstration
* Question and answer
* Problem solving
* Experiential
* Team training
* Guest speakers

**Recommended Resources for 30 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| **A** | **Learning Materials** |  |  |  |
|  | Textbooks | Comprehensive texts books on Entrepreneurial Skills | 30 pcs | 1:1 |
|  | PowerPoint Presentations | For trainer’s use, covering course content and practical applications | 1 | 1:30 |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:30 |
|  | Media Resources | These include but are not limited to:   * Video Clips * Audio Clips * TV Sets * Radio Sets * Newspapers * Business Journals * Case studies |  |  |
|  | Templates | Templates for creating various documents e.g. business plan, invoices etc. | 30 | 1:1 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:30 |
| **B** | **Learning Facilities & Infrastructure** |  |  |  |
|  | Lecture/Theory Room  /Learning Resource  Area\* | Spacious, equipped with projectors and Seats for 30 trainees, approximately 45 sqm (5 m x 9 m) | 1 | 1:30 |
|  | Computer Laboratory | Equipped with at least 15 functional computers with internet connectivity and the following software:   * + - Windows/ Linux/ Macintosh Operating System     - Microsoft Office Software     - Google Workspace Account     - Antivirus Software | 1 | 1:1 |
|  |  |  |  |  |
| **C** | **Consumable Materials** |  |  |  |
|  | Writing Materials | Writing materials for note taking | Enough |  |
|  | Flashcards | For carrying out various activities by trainees | Enough |  |
|  | Charts | Sufficient for group work activities and displaying | Enough |  |
|  | Whiteboard Marker Pens | Dry-erase markers for trainer’s use. Assorted colors | Enough |  |

## HYDRAULIC SYSTEMS INSTALLATION AND MAINTAINANCE

**UNIT CODE:** 0714 451 12A

**Relationship to occupational standards**

This unit addresses the unit of competency: Install and maintain hydraulic system

**Duration of unit:** 220 hours.

**Unit description**

This unit covers the competencies required in installation and maintenance of hydraulic systems according to the design considerations and installation standards. These competencies include; conducting hydraulic system site survey, planning hydraulic system installation, installing hydraulic system and maintaining hydraulic systems.

**Summary of Learning outcomes**

By the end of the unit of learning, the trainee will be able to;

|  |  |  |
| --- | --- | --- |
| S/No | Learning Outcome | **Duration (Hrs.)** |
| 1 | Apply heat transfer and heat exchangers in fluid | **10** |
| 2 | Apply knowledge of flow of fluids | **10** |
| 3 | Apply knowledge of viscous flow of fluids | **10** |
| 4 | Operate fluid pumps | **10** |
| 5 | Conduct hydraulic system site survey | **30** |
| 6 | Plan hydraulic system installation | **30** |
| 7 | Install hydraulic system | **70** |
| 8 | Maintain hydraulic system | **50** |
|  | **TOTAL** | **220 HRS** |

**Learning outcomes, content and suggested assessment methods**

| **Learning outcome** | **Content** | **Suggested assessment methods** |
| --- | --- | --- |
| * 1. Apply heat transfer and heat exchangers in fluid | * 1. Heat transfer media      1. Heat transfer methods:         1. Conduction         2. Convection         3. Radiation      2. Newton's law of Cooling      3. Derivation and application of Fourier's\* law of heat conduction equation   2. Heat transfer by conduction   through   * + 1. Slab        1. Thermal conductivity        2. Temperature gradient     2. Composite wall     3. Thick cylinder     4. Thick sphere   1. Overall coefficient of heat transfer      1. Heat exchangers | * Written tests |
| * 1. Apply knowledge of flow of fluids | * 1. Types of fluid flow      1. Steady and unsteady flows      2. Uniform and non-uniform flows      3. Rotational and irrotational flows      4. Laminar and turbulent flows      5. Compressible and incompressible flows   2. Loss of energy (or Head) in Pipes      1. Darcy-weisbach formula      2. Chezy’s formula for loss of head due to friction      3. Loss of head due to sudden enlargement      4. Loss of head due to sudden contraction      5. Loss of head due to obstruction in pipe      6. Loss of head at the entrance to pipe      7. Loss of head at the exit of a pipe      8. Loss of head due to bend in the pipe   3. Hydraulic gradient and total energy lines      1. Pipes in series or compound pipes      2. Pipes in parallel      3. Power transmission through Pipes | * Written tests |
| * 1. Apply knowledge of viscous flow of fluids | * 1. Flow of viscous flow      1. Flow of viscous fluid in circular pipes      2. Flow of viscous fluid through an annulus      3. Flow of viscous fluid between two parallel plates         1. One plate moving and other at rest         2. Both plates at rest         3. Both plates moving in opposite directions      4. Kinetic energy correction and momentum      5. Power absorbed in viscous flow      6. Viscous resistance of journal bearings      7. Viscous resistance of foot-step      8. Viscous resistance of collar bearing | * Written tests |
| * 1. Operate fluid pumps | * 1. Principles of operation of:      1. Reciprocating pumps      2. Centrifugal pumps   2. Derivation of equations for a reciprocating pump      1. Coefficient of discharge      2. percentage slip      3. Work done      4. Acceleration head      5. Friction head      6. Pressure head in the cylinder   3. Application of reciprocating pumps equations to solve problems   4. Derivation of equations for a centrifugal pump      1. Effective head      2. Manometric head      3. efficiency      4. Mechanical efficiency      5. Discharge      6. Torque      7. Work done unit weight      8. Specific speed   5. Application of centrifugal pumps equations to solve problems | • Written tests |
| 1. Conduct hydraulic system site survey | * 1. Site survey aspects      1. User requirements      2. System requirements      3. Space and layout      4. Environmental considerations      5. Power sources      6. Safety regulations and standards      7. Instrumentation systems      8. Status of existing systems      9. Scalability      10. Reliability      11. Cost   2. Survey Tools and Equipment      1. Required tools         1. Tape measure         2. Laser distance meter         3. Camera         4. Flow meters         5. Pressure gauges         6. Stationery         7. Thermometer         8. Ladder         9. Flashlight         10. Leakage testers         11. Hand tools      2. Required equipment         1. Leakage testers         2. Hydraulic fluid analysis kit         3. Hydraulic pressure testing kit         4. Ladder   3. Conduct the Site Survey      1. Execute site survey as per work requirements      2. Document findings   4. Generate Survey Report      1. Prepare a comprehensive site survey report      2. Follow workplace procedures for documentation | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |
| 1. Plan hydraulic system installation | * 1. Introduction to Hydraulic Systems      1. Fundamentals of Hydraulics         1. Definition and principles of hydraulics         2. Applications in various industries         3. Advantages of hydraulic systems over other systems      2. Types of hydraulic system components and their operations.         1. Hydraulic fluids,         2. pumps,         3. valves         4. actuators,         5. filters      3. Types of hydraulic cylinders (single-acting, double-acting)   2. Operation and control      1. System operation      2. Basics of hydraulic control systems      3. Flow control and pressure regulation   3. Automation in hydraulics      1. Introduction to electronic controls      2. Integration with PLCs and other control systems   4. System design      1. Hydraulic circuit design principles      2. Sizing and selecting hydraulic components   5. Installation workplan preparation      1. Outline tasks and timeline      2. Identify resources and personnel   6. Hydraulic system supplies specifications      1. Pressure gauges      2. Vacuum gauges      3. Pressure regulators      4. Pipes      5. Connectors      6. Air compressors      7. Hydraulic Valves      8. Enclosures      9. Hydraulic cylinders and pumps      10. Fluid reservoirs      11. Hydraulic fluid      12. Sealing and fasteners      13. Mounting hardware      14. Installation tools and equipment      15. Electrical supplies      16. Safety equipment   7. Practice:      1. Design automatic hydraulic systems      2. Prepare a workplan for automatic hydraulic system | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |
| 1. Install hydraulic system | * 1. Types of PPE      1. Helmets,      2. Gloves,      3. Goggles   2. Hydraulic piping      1. Hydraulic tubing      2. Hydraulic hoses      3. Hydraulic fittings      4. Flanges      5. Couplers      6. Manifolds      7. Filters      8. Check valves      9. Pressure relief valves      10. Supports and brackets      11. Flow control valves   3. Mounting accessories:      1. Breathers and filters      2. Pressure gauges      3. Temperature gauges      4. Level gauges      5. Sight glasses      6. Pressure switches      7. Coolers and heat exchangers      8. Accumulators      9. Valves   4. System testing:      1. Functionality test      2. Leakage test      3. Pressure test      4. Temperature test      5. Flow rate test      6. Noise and vibration test   5. Calibration of hydraulic controls   6. Site Housekeeping and waste disposal      1. Packaging material      2. Faulty components and equipment   7. Practice: Install automatic hydraulic systems | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |
| 1. Maintain hydraulic system | * 1. Maintenance Schedule Creation   2. Tools and Spares:      1. Tools      + Hand tools      + Pressure gauge      1. Equipment      + Lifting gear      + Hydraulic press      + Hydraulic flushing unit      + Hydraulic test bench      + Hydraulic hose crimping machine      1. Spares      + Hydraulic hoses      + Hydraulic fittings      + Hydraulic fluid      + Hydraulic filters      + Hydraulic valves      + Hydraulic cylinders      + Hydraulic pump seals   3. Maintenance tasks:      1. Inspection      2. Testing and measurements      3. Fluid level check      4. Fluid condition check      5. Cleaning      6. Tightening      7. Lubrication      8. Pressure check      9. Replacing components      10. Replacing consumables   4. Technical reporting and documentation   5. Practice: Maintain installed hydraulic systems | * Project * Practical * Third party report * Portfolio of evidence * Written tests * Oral questioning |

**Suggested delivery methods**

* Group discussions
* Demonstration by trainer
* Online videos
* Power point presentation

**Recommended resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/item** | **Description/specifications** | **Quantity** | **Recommended ratio (item: trainee)** |
| **A** | **Tools** | | | |
|  | Hand Tools | Complete set including wrenches, screwdrivers, and pliers | 5 pcs | 1:5 |
|  | Pressure gauges | For measuring hydraulic pressure | 5 pcs | 1:5 |
|  | Multimeters | For measuring voltage, current, and resistance | 5 pcs | 1:5 |
|  | Hydraulic hose crimping tool | For crimping hydraulic hoses | 5 pcs | 1:5 |
|  | Flow meters | For measuring the flow rate of hydraulic fluids | 5 pcs | 1:5 |
|  | Laser distance meters | For measuring distances accurately, shared between two trainees | 5 pcs | 1:5 |
| **B** | **Learning facilities & infrastructure** | | | |
|  | Lecture/theory room | Approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Approximately 80 sqm | 1 | 1:25 |
|  | Laboratory | Approximately 80 sqm | 1 | 1:25 |
|  |  |  |  |  |
| **C** | **Materials and supplies** | | | |
|  | Hydraulic fluid | 20 liters per trainee for operations | 500 liters | 20L:1 |
|  | Hydraulic hoses | 10 meters per trainee for various applications | 250 meters | 10m:1 |
|  | Connectors, fittings, seals | Sets for hydraulic connections | 500 sets | 20 sets:1 |
|  | Pipes (Various Sizes) | For plumbing and installation in hydraulic systems | 125 meters | 5m:1 |
|  | Mounting brackets and fasteners | For securing hydraulic components | 250 pcs | 10:1 |
|  | Safety gear (ppe) | Complete sets including helmet, gloves, goggles, safety shoes, and harness | 25 sets | 1:1 |
|  |  |  |  |  |
| **D** | **Equipment** | | | |
|  | Hydraulic test benches | For conducting pressure tests on hydraulic systems | 2 units | 2:25 |
|  | Hydraulic pumps | For generating hydraulic pressure | 2 units | 2:25 |
|  | Hydraulic motors | For driving hydraulic systems | 2 units | 2:25 |
|  | Hydraulic cylinders | For providing force in hydraulic systems | 2 units | 2:25 |
|  | Hydraulic power units | For powering hydraulic systems | 2 units | 2:25 |
|  | Hydraulic pressure testing kits | For testing pressure levels in systems | 2 units | 2:25 |
|  | Sensors | Assorted | 10 | 2:5 |
|  | Controllers | For controlling automatic hydraulic system | 5 | 1:5 |
|  |  |  |  |  |
| **E** | **Equipment** | | | |
|  | Hydraulic fluid analysis kits | For analyzing the quality of hydraulic fluid | 2 units | 2:25 |
|  | Leakage testers | For detecting leaks in hydraulic systems | 2 units | 2:25 |
|  | Vacuum pumps | For creating vacuum conditions | 2 units | 2:25 |
|  | hydraulic training kit | For training | 2 units | 2:25 |
|  |  |  |  |  |
| **F** | **Reference materials** | | | |
|  | Hydraulic system manuals | Comprehensive guides for understanding hydraulic systems | 5 copies | 1:5 |
|  | Hydraulic system design blueprints | For understanding layout and design of hydraulic systems | 5 copies | 1:5 |
|  | Occupational health and safety (OHS) guidelines | For ensuring safety practices are followed | 1 copy | 1:25 |
|  | Technical documentation for hydraulic components | Detailed information for components | 5 sets | 1:5 |
|  | System Troubleshooting Guides | For diagnosing and solving system issues | 25 copies | 1:1 |